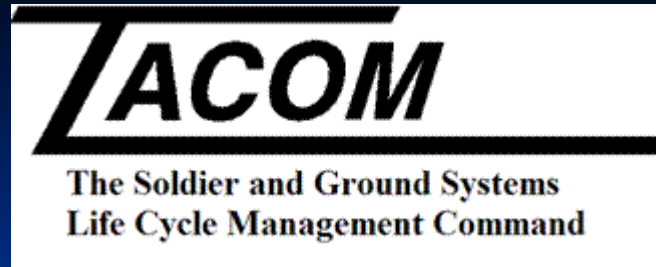


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Transparent Armor Cost Benefit Study

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TACOM Cost & Systems Analysis Directorate**

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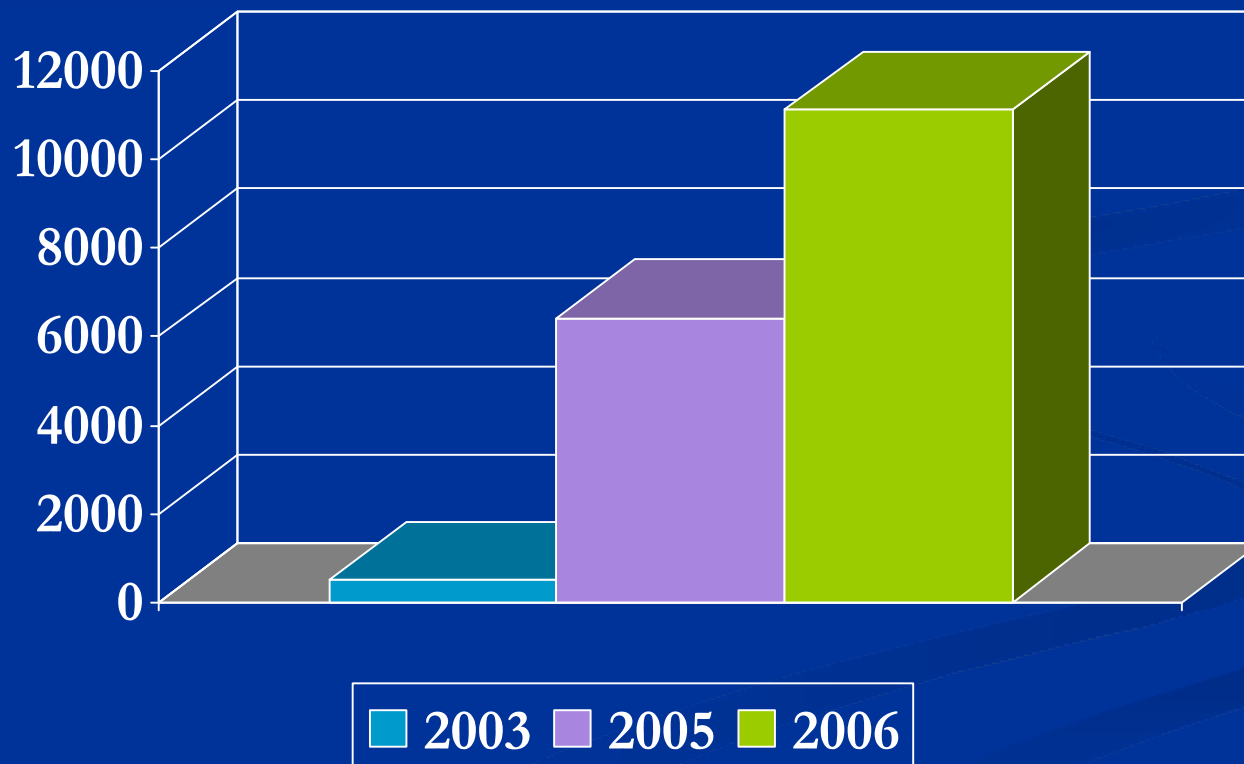
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Agenda

- Background
- Current Demand Data
- Government Cost/Benefit Analysis
- Timeline

Equipping Our Soldiers in Iraq and Afghanistan

Up-Armored HMMWVs (M1114s)



Recent History

Early OIF



Curb Wt: 10,300lbs
GVW: 12,100lbs

2004-2005 - GPK



2006

“Iraqi Pope Glass”

Future Transparent Gun Shields

- Requirement: Upgrade GPKS with transparent armor for enhanced situational awareness while maintaining soldier cover within armor envelope.

Baseline



AH1 GS & GPK



Field Modified GS & APK

Initial



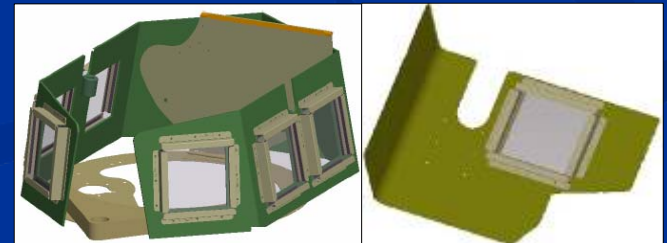
Upgraded Gunner Shield – Transparent Armored Gun Shield (TAGS)

Interim



Interim Solution – Marine Corps TAGS (MCTAGS)

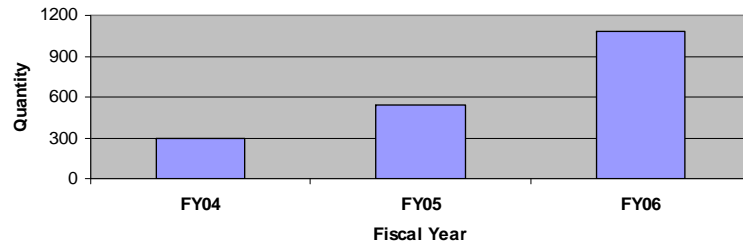
Objective



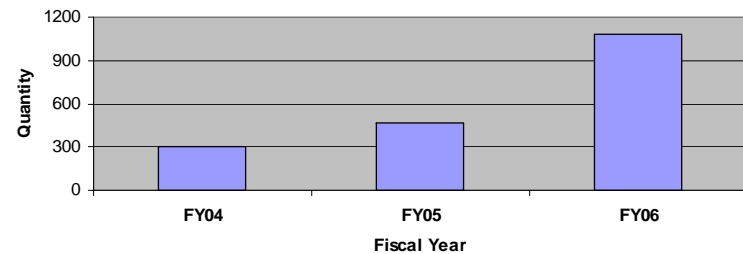
Future Solution – Modified Solution based upon theater recommendations

HMMWV M1114 Glass Demand

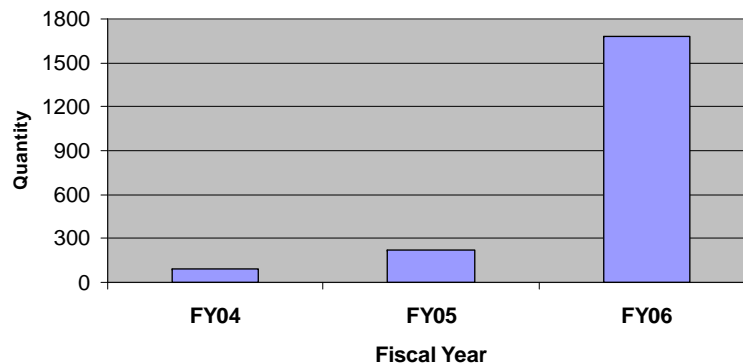
Left Windshield Average Monthly Demand



Right Windshield Average Monthly Demand



Door Window Average Monthly Demand



- Over \$5.2 Million was spent per month in FY05 for the Up-Armored HMMWV windshields and door windows.
- Demand for both right and left windshields increased 133% and 101% respectively from FY05 to FY06.
- Demand for door windows increased 658% from FY05 to FY06.

Bottom Line: Army needs an improved Transparent Armor solution!

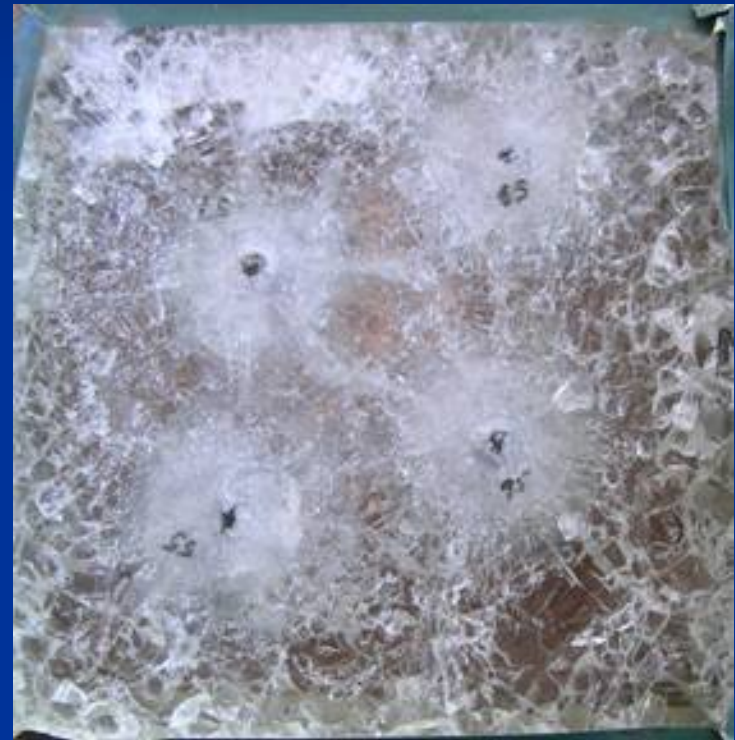
Increase In Door Glass Demand



- Soldiers are adding another piece of glass to each door for added protection.
- Adds additional weight to an already overweight vehicle and reduces payload capacity!

Causes Of Current Glass Failures

- Insurgent Attacks
(with a wide range of threats)
- Sandstorm Damage
- Rock Strikes
- Improper removal and installation
- Clouding
 - Delamination caused by environmental degradation
 - Improper curing process
 - Improper cleaning techniques



Other Problems with Current Glass

■ Weight

- Weight of current glass solution adds significant weight to vehicle.

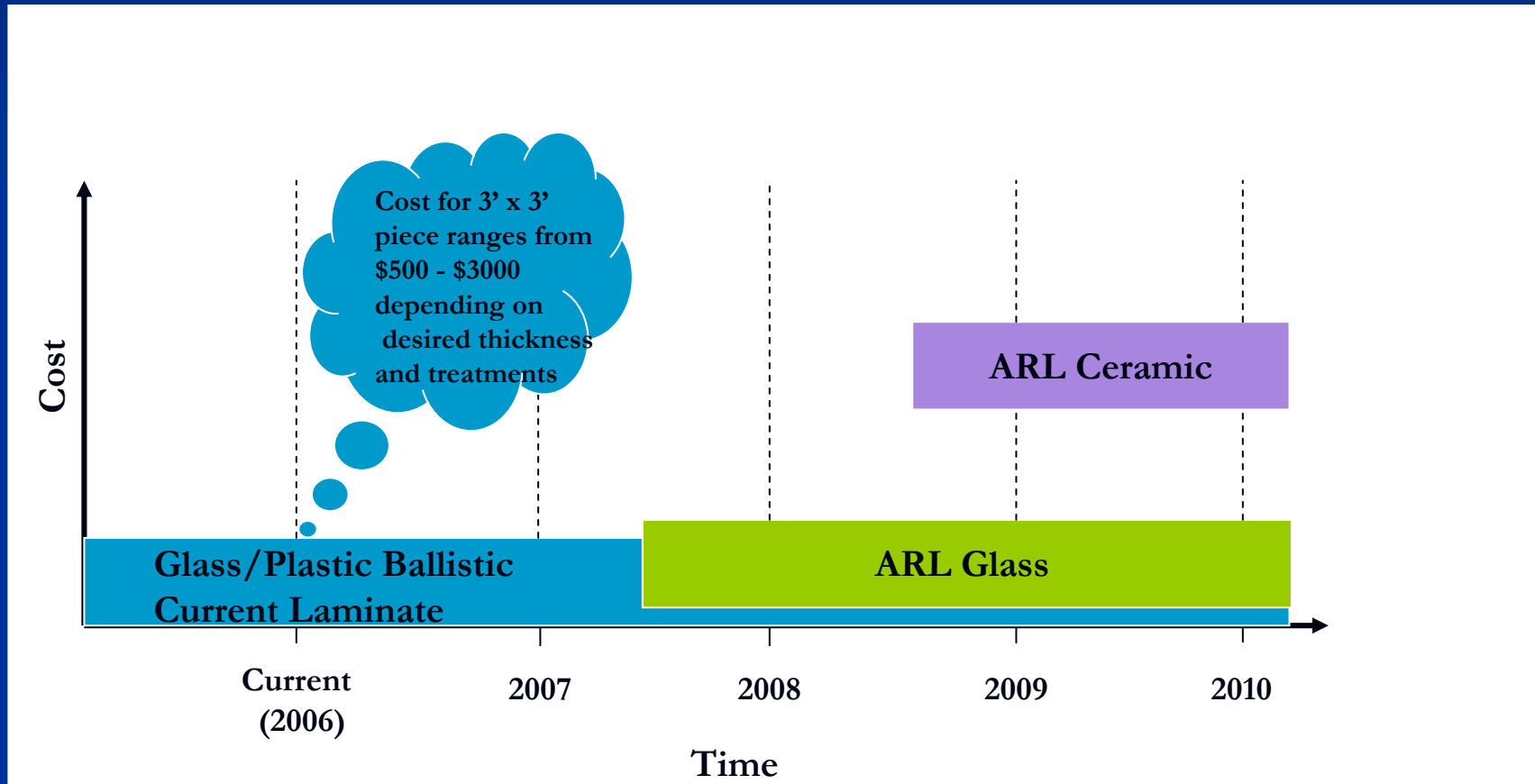
■ Visibility

- Thickness of glass can cause distortion and glare

Future Transparent Armor Solutions

<u>Failure Causes</u>	<u>Potential for Improvement over Current Laminate Technology</u>
■ Insurgent Attacks (with a wide range of threats)	Yes/No (Depends on Threat)
■ Sandstorm Damage	Yes
■ Rock Strikes	Yes
■ Improper removal and installation	Yes
■ Clouding	
- Delamination caused by environmental degradation	Yes
- Improper curing process	Yes
- Improper cleaning techniques	Yes

Future Transparent Armor Solutions



ARL – Army Research Lab

Basic Research Effort

- GE Global Research and Nanocerox partnership
- Goal is to develop nano-structured ceramic bodies with a combination of high optical transmission and exceptional mechanical properties and capable of effective performance in an outstanding transparent armor system.
- Two Funding Opportunities of Effort:
 - FY05: Develop design rules from the system level armor requirements to the mechanical and optical properties of the ceramic body and then into the properties of the nanopowder. Objective is for a process to be in place for the fabrication of 2" x 2" x 0.375" samples.
 - FY06: Scale up the materials systems to a final dimension of 4" x 4" x 0.375". Characterize and deliver samples for ballistic testing.

Government Cost Benefit Study

Purpose: Determine break-even cost for new transparent armor solution based on expected reliability improvement and required investment.

- Use current fleet of Up-Armored HMMWV as the study platform for initial look.
- Approximately 11,000+ vehicles in Army inventory.
- NSN 2510-01-435-9693
Right Windshield \$2,759 (FY06\$)
- NSN 2510-01-435-9690
Left Windshield \$2,759 (FY06\$)
- NSN 2510-01-435-9692
Door Window \$1,025 (FY06\$)
- Expand analysis to include rest of TWV fleet.



Cost-Benefit Methodology

Obtain current demand data and cost data to determine operations cost for status quo.

✓ Completed

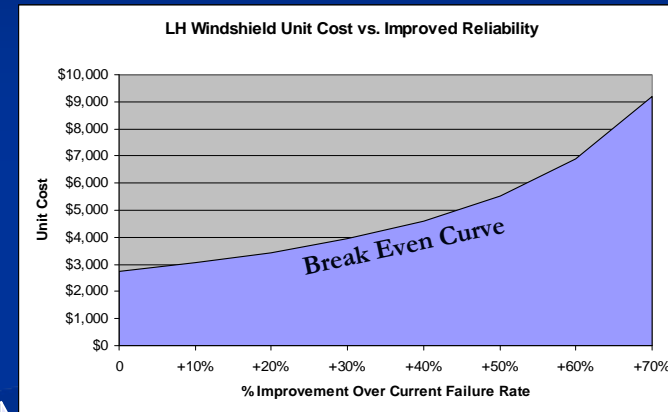
Obtain investment costs for new transparent armor.

Determine operations cost for transparent armor solution.

Determine savings between status quo and transparent armor alternative.

Calculate Net Present Value and Savings to Investment Ratio.

Parametric Analysis

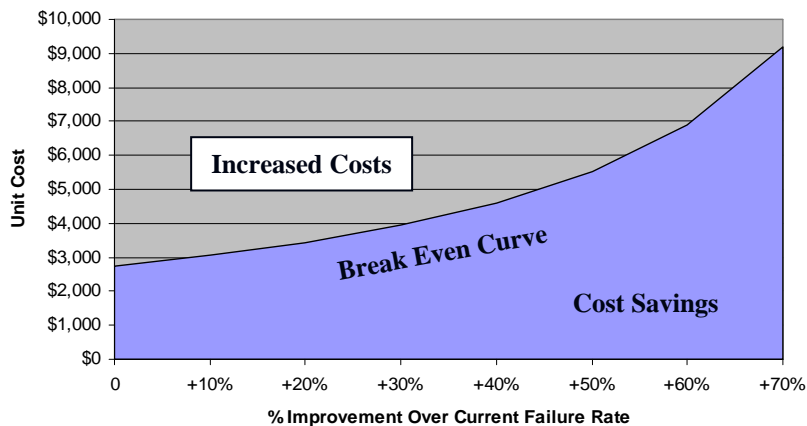


Contractor provides reliability improvement factor estimate and estimated cost for transparent armor Material at end of Phase I.

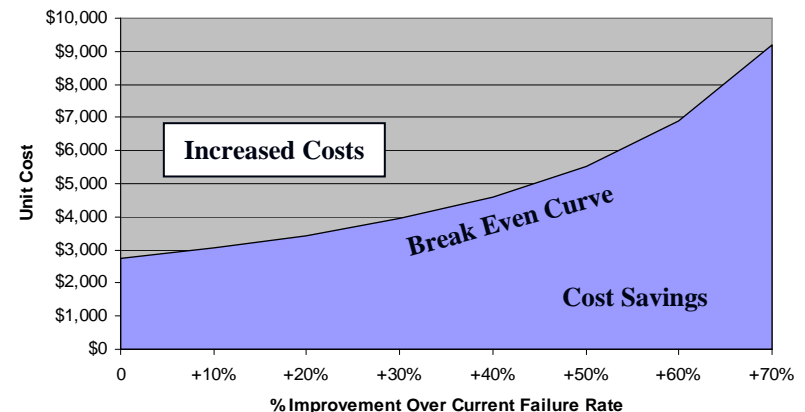
Cost Benefit Parametric Analysis

Up-Armored HMMWV Glass

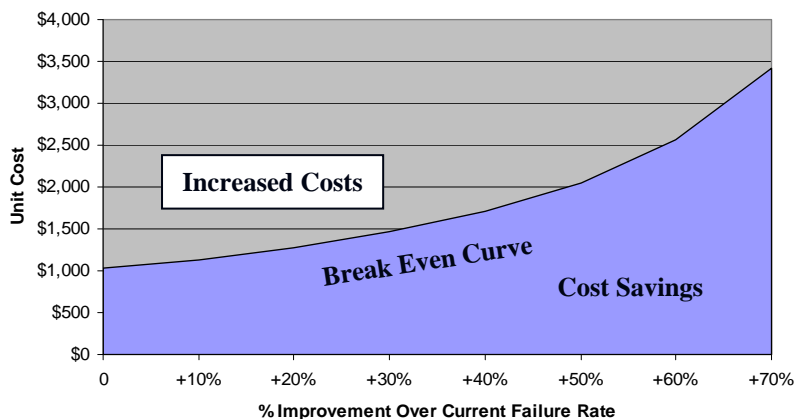
LH Windshield Unit Cost vs. Improved Reliability



RH Windshield Unit Cost vs. Improved Reliability



Door Window Unit Cost vs. Improved Failure Rate



Curves Based on the FY05 Demand Data

Other Potential Benefits of a New Transparent Armor Solution

- Vehicle Weight
- Logistics Footprint
- Crew Survivability
- Platform Operational Availability
- Safety related accidents

Impact



Timeframe

